Rubber Research Scheme

(CEYLON).

Second Quarterly Circular

FOR

1925.

Peradeniya, July, 1925.

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GENTLEMEN,

Herewith the Second Quarterly Circular for 1925 dealing with the following subjects:—

"Milky Serum."
"Formic Acid as Coagulant."
By T. E. H. O'Brien, Chemist.

"Observations on the amount of Nitrogen lost as a result of secondary leaf-fall."

"Suggestions for a Manuring Experiment suitable for estate practice."
By R. A. Taylor, Physiological Botanist.

" The present position with regard to leaf diseases of Rubber."
By R. H. Stoughton-Harris, Mycologist.

Reports received.

J. MITCHELL,
Organising Secretary.

RUBBER RESEARCH SCHEME (CEYLON),
Peradeniya, 7th August, 1925.

"MILKY SERUM"

It has frequently been noted in visiting estates that the serum remaining after coagulation is distinctly milky in appearance. The usual opinion is that this serum contains no rubber, and in the case of sheet manufacture it is sometimes stated that in order to make good sheet, the amount of acid must be regulated so that a milky serum remains.

It has always been recognised by the writer that milky serum contains appreciable quantities of rubber, but it was of little consequence when rubber was only worth 50 cents a pound. With rubber selling at Rs. 2.70 per pound it is a different matter, and it was thought of interest to estimate the amount of rubber which is lost in this way.

Tests were carried out on 2 estates giving the following results:—

Estate No. 1.

Weight of rubber recovered from 3½ gallons of serum ...	... 11.1 grams.
Estimated bulk of serum daily	... 500 gallons.
Estimated loss of rubber daily	... 3.6 lbs.
Value at Rs. 2.70 per lb.	... Rs. 9-70

Estate No. 2.

Weight of rubber recovered from 1 gallon of serum ...	... 6.6 grams.
Estimated bulk of serum daily	... 500 gallons.
Estimated loss of rubber daily	... 7.3 lbs.
Value at Rs. 2.70 per lb.	... Rs. 19.70

The additional amount of acetic acid required to prevent this loss would cost about 50 cents.

The above figures speak for themselves, and it is strongly recommended that sufficient acid should be used to ensure complete coagulation. It will be found in most cases that an additional ounce of acid per Shanghai jar will be sufficient to do this.

T. E. H. O'BRIEN,
Chemist.

RESEARCH SCHEME LABORATORIES,
Culloden,
July 27th, 1925.

FORMIC ACID AS COAGULANT.

In the early days of the Plantation Industry, formic acid, in common with most well known acids, was tested as a coagulant for rubber. It was found to be a satisfactory coagulant, having a stronger coagulating power than acetic acid. It could not however compete in price with acetic acid, and was never used to any great extent.

Interest in the subject has recently revived owing to the fact that supplies of formic acid have now become available at a price which would make it a cheaper coagulant than acetic acid.

The manufacturers of formic acid claim that 1 part of formic acid coagulates twice as much rubber as 1 part of acetic acid. The most recent quotation for formic acid (90%) delivered Colombo is £48. 18. 0 per ton, compared with £58 for acetic acid, thus showing an apparent saving of more than 50% on present coagulating charges.

It should be pointed out however that, as far as can be ascertained, the tests mentioned by the makers refer to a comparison of equal **Volumes** of acid, while the price is for equal **Weights**. The weight of 1 gallon of formic acid is 2 lbs., whilst 1 gallon of acetic acid weighs only 10.5 lbs. It will therefore be seen that if a comparison is made on the same basis on which the acid is sold the relative amounts of acetic and formic acid would be not 100: 50, but 100: 57. Confusion between volume and weight probably accounts for the different figures given for the efficiency of formic acid.

Samples of formic acid were received by the Research Scheme from two different sources, one being American and the other Dutch. Formic acid is made in different grades ranging in strength from 80 to 90%. The samples supplied were respectively 85% and 90%, these figures being confirmed by analysis. The acetic acid with which they were compared was of the usual strength, *i.e.*, 98—99%.

As a result of a number of tests carried out both in the laboratories and in factories in the Kalutara district, at dilutions suitable for manufacture of both sheet and crepe, and on estates tapping on 2-day and 3-day systems, it was

established that 1 part by **Volume** of 90% formic acid coagulates approximately as much rubber as 2 parts of acetic acid, thus substantiating the claim of the manufacturers. 85% acid, as would be expected, was found to be approximately 5% less efficient.

A comparison can now be made of the relative cost of coagulation with formic acid and acetic acid. On a **Weight** basis, 57 parts of 90% formic acid are equal in coagulating power to 100 parts of acetic acid. The prices being as mentioned above, the saving on coagulation costs would amount to just 55%.

So much for cost, but this is not the only factor of importance in the choice of a coagulant. It is essential that the appearance and vulcanising properties of the rubber should be satisfactory.

As regards the first point it can be said that rubber coagulated with formic acid is at least equal in appearance to rubber coagulated with acetic acid. Owing to the fact that formic acid has slight antiseptic and "reducing" properties it will probably be found that the amount of bisulphite used in crepe manufacture can be slightly reduced. It can also be surmised that there will be slightly less tendency to "bubbles" in sheet.

The Rubber Research Scheme has not carried out vulcanisation tests on rubber coagulated with formic acid, but results of tests from other sources are available. The Consulting Chemist to the Rubber Growers Association reports, as a result of preliminary tests (R. G. A. Bulletin, vol. 6, p. 697), that formic acid coagulated rubber is equal in strength to acetic acid coagulated rubber, but vulcanises slightly more slowly. Similar results have been obtained in tests carried out by the Experimental Stations in Java, and the Government Research Institute in Holland, it also being stated by the latter that the difference in rate of vulcanisation disappears in presence of "accelerators."

The R. G. A. has now arranged for large scale samples of formic acid rubber to be tested by manufacturers, and in the meantime Estates wishing to experiment with formic acid can do so without risk of spoiling their rubber.

It is considered by the Research Scheme that formic acid could now profitably be adopted as a coagulant, and estates might obtain supplies of the acid and make experiments with it.

In testing the acid it should be remembered that 1 part of 90% acid has approximately the same coagulating power as 2 parts of acetic acid. With the 85% acid a slightly larger quantity will be required. It will be found most convenient to use the same amount of liquid for coagulating as previously, *i.e.*, if the present factory formula consists of 8 oz. of acetic acid in 7 pints of water per Shanghai jar than 4 oz. of formic acid should be used in the same quantity of water.

If strong formic acid comes in contact with the skin it causes blisters unless immediately washed off, so it must be handled with the degree of care that is usual with acetic acid.

No definite figure can be given for the weight of dry rubber which should be obtained for a given quantity of acid, as this will vary on different estates and also depends on the dilution of the latex. On estates in the Kalutara district it was found that 1 pound of acetic acid coagulated approximately 200 lbs. of rubber at 2 lbs. per gallon dilution, and 170 -180 lbs. at 1½ lbs. per gallon (for rolling the following morning).

T. E. H. O'BRIEN,
Chemist.

RESEARCH SCHEME LABORATORIES,
Culloden,
July 26th, 1925.

OBSERVATIONS ON THE AMOUNT OF NITROGEN LOST BY TREES AS A RESULT OF PHYTOPHTHORA ATTACK.

It is thought that the figures given below may be of interest as a rider to the note in the last Quarterly Circular on the nitrogen content of leaves shed during wintering.

As stated in that article, it is a generally accepted fact that a plant normally withdraws at least a portion of the food-stuffs from the leaves before they are shed, but the leaf-fall due to Phytophthora comes under a different category. Here the fall is not due to normal physiological causes but to the action of a fungus, and the figures show, as might be expected, that a much greater proportion of the nitrogen is lost.

The fact that the leaves as they fall contain only two-thirds as much nitrogen as normal leaves still on the tree does not prove that the tree has withdrawn the difference; in fact such a possibility is rather remote. The leaf is killed by the fungus and so is the petiole or leaf stalk, and that means that the mechanism for transport, if not completely interrupted, at least has its efficiency seriously impaired. When any tissue dies the membranes of its cells, which control the movements of the various substances from cell to cell, are destroyed, and, this control being removed, the substances are free to move through all the tissue. Enzymes or ferments are thus released and are free to act on anything that they come in contact with. Hence the proteins, which contain a large proportion of the total nitrogen, are broken up in a short time to form amino-acids and later ammonia. This formation of ammonia is doubtless the reason for the decrease in nitrogen content.

In the case under observation we also have the fungus present and many fungi in breaking up the plant tissues,

for their own use, liberate ammonia. It seems probable therefore that all the nitrogen contained in the leaf is lost.

The figures are as follows :—

The diseased leaves used were collected as they fell, and the controls were taken from a branch which at the time was disease free.

	Diseased Leaves.	Normal Leaves.
Nitrogen Content as percentage of dry weight ...	2.16% ...	3.15%

It will be noticed that the figure for normal leaves is lower than that in the previous note, 3.15% as compared with 3.385%. This is no doubt due to the fact that the leaves are now older, and will contain considerably more woody tissue, which is not so rich in nitrogen.

The loss of foodstuffs incidental to leaf-fall is however only a small part of the strain to which the tree is subjected. The whole manufacturing portion of the plant is affected and while the tree is leafless it is, so to speak, living on capital. What reserves are available must be encroached upon for the production of the new foliage as well as for the normal "running expenses," such as production of latex, renewal of bark, etc., and this, unlike the nominal wintering, occurs when the tree has made no special preparation.

R. A. TAYLOR,
Physiological Botanist.

RESEARCH LABORATORIES,
Culloden Estate,
Neboda,
July 26th, 1925.

SUGGESTIONS FOR A MANURING EXPERIMENT SUITABLE FOR ESTATE PRACTICE.

With rubber at its present price there seems every likelihood that many estates will next year be considering manuring programmes. The following is suggested as a means of testing the efficiency of any particular manure, and is considered suitable for practically any estate.

It is assumed that a knowledge of the effect of one manure only is desired, but in the event of two such being employed, the experiment can easily be duplicated.

A block in which the trees are in distinct rows in at least one direction is desirable, and the block should be as uniform as possible both as regards nature of the soil and lie of land.

Twenty plots of about twenty-five trees each will give sufficient duplication if allotted 10 to manure and 10 to control. This would mean that 250 trees are being manured, and an application at the rate of 10 lbs. per tree means that approximately one ton of manure will be required.

It will be most convenient to have each plot consisting of 25 trees in one row, and to have manured and control plots alternately with one row between, as shown in the diagram. The yield of these latter rows will not be considered so it will be seen that 25 records will have to be kept.

The design given below is intended for an estate where the tapping system consists of one cut on $\frac{1}{2}$ circumference with a six-monthly or annual change-over. Once the plots are marked out it is essential that yield records should be kept for one whole year before any manure is applied.

The only treatment to be received by the plots at the outset will be forking. All the plots should be forked in the same way as it is intended to fork when manure is actually applied. The first year's records will give some measure of the capabilities of the plots before any manurial treatment, and the forking will ensure that any subsequent increase in yield will be due to the manure and not to the cultivation incidental to application, as has been found to be the case in certain previous experiments. The full year's record is essential as it is a well known fact that some trees yield more on one side than on the other, and with any shorter period it will not be possible to test both panels.

Plot A ...	A A A . . .	A A A . . .	A A A . . .	A A A . . .	A A A . . .	A A A . . .	A A A . . .	A A A . . .	Manure
Barrier ...	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
Plot B ...	B B B . . .	B B B . . .	B B B . . .	B B B . . .	B B B . . .	B B B . . .	B B B . . .	B B B . . .	Control
Barrier ...	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
Plot C ...	C C C . . .	C C C . . .	C C C . . .	C C C . . .	C C C . . .	C C C . . .	C C C . . .	C C C . . .	Manure
Barrier ...	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
Plot D ...	D D D . . .	D D D . . .	D D D . . .	D D D . . .	D D D . . .	D D D . . .	D D D . . .	D D D . . .	Control
	Tapper's Task.	Tapper's Task.							

Tappers' Tasks.—It is well known that some tappers can get more latex than others from the same trees. Thus a considerable error can be introduced by having some plots tapped by some tappers and some by others. As will be noted from the diagram the plots will be linear in shape and will consist of about 25 trees. For the sake of argument let us assume that there are 24 trees in each, and that there are 8 tappers employed. It will then be possible to more or less eliminate the personal factor if each tapper taps 3 trees in each plot. Thus the tappers' tasks will also have to be linear in shape, consisting of bands, 3 trees in width, running at right angles to the long axis of the plot.

Marking out of the Plots.—It is suggested that each plot be given a letter and that all the 24 trees in "A" plot be marked with an "A," all in "B" with a "B," etc. The rows between the plots being "barrier" rows should be marked with a red band, to prevent mistakes during collection. The trees in the tappers' tasks will also have to be distinctively marked, *e.g.*, each tree in Ramasamy's task might have a green dot or band, and those in Mutusamy's task, lying alongside, a white dot or band.

Collection of Latex.—A collecting tin ought to be provided for each plot and stamped with a letter to correspond. The latex should be taken to the Factory in these for measurement, for coagulation and subsequent weighing of the dry rubber. The latex from the barrier rows is not to be measured and can be collected by any other tappers in the ordinary way.

It is suggested that forking be done as soon as possible after the re-opening of the cuts in March or April, and record keeping commenced at the beginning of September. Records should be kept for 12 months and the manures applied during the following January.

Mathematical interpretation of the results will be undertaken by the Rubber Research Scheme, if desired.

R. A. TAYLOR,
Physiological Botanist.

Note.— The fact that 10 lbs. manure per tree is suggested does not necessarily mean that manuring generally would amount to applications of 1,000 lbs. per acre. This heavy application on the Experimental Plot is to ensure that any effect will be obvious.

THE PRESENT POSITION WITH REGARD TO LEAF DISEASES OF RUBBER.

It is a fact perhaps not generally realized that the world's economic crops suffer greater losses through leaf diseases than by any other means. This is not surprising when it is remembered that a plant is dependent for practically the whole of its organic food-supply upon its leaves. Any cause which leads to a loss of leaves or which affects their efficiency as food-producers must sooner or later result in a serious loss to the plant.

In a crop such as rubber this effect is less readily discernible, since, so far as is known at present, the leaves only indirectly influence the production of latex. None the less, if the tree loses foliage its general health must be affected, its supply of food-material restricted, and ultimately its latex-producing power decreased. So far there is no direct evidence in Ceylon that secondary or Phytophthora leaf-fall has led to any serious reduction of crop, but the effect may have been masked by other factors which have improved yields. In any case the fact remains that the tree suffers and is put to a considerable strain by the partial defoliation.

The rubber tree is liable to a number of leaf diseases, of which only one certainly, but possibly two, are of really serious importance. These are the well-known secondary leaf-fall, due to *Phytophthora Faberi* in Ceylon, and the new early leaf-fall caused by *Oidium sp.* It yet remains to be seen whether the latter will become sufficiently severe to rank with the former in importance, but if it should occur in the future with an intensity equal to that which it showed this year, then it may become one of the important diseases of rubber.

There are in general three recognized methods of combating leaf-diseases; spraying with a suitable fungicide, cultural methods, such as manuring, cultivation of the soil, and the application of suitable chemicals to the soil, and finally the breeding of resistant varieties.

With such a crop as rubber, difficulties are found in connection with all these methods.

Breeding of Resistant Varieties.—The main difficulty here is the length of time that is taken in raising the required

number of generations. Even if the offspring of a resistant tree were all resistant it would require some ten to fifteen years to raise a stock of any size, while if the resistance-factor followed the laws of Mendelian heredity it would need three or four generations of trees for the same purpose. The Rubber Research Scheme is at present working on selection of rubber, and among other factors that of disease-resistance will be considered.

Cultural Methods.—Experiments are in progress along these lines at the present time. On two estates in the Kalutara district the effect of manuring with nitrate of soda on the incidence of leaf-fall is being tried and in another more extensive manuring experiment close attention will be paid to this aspect of the question. There is some evidence to show that trees which have been heavily manured (such as those standing near cattle-sheds) suffer less from attacks of Phytophthora, but on the other hand these showed no special resistance to Oidium in the early part of this year.

On the whole it is usually the case that any means whereby the general health and vitality of a plant is improved increases the resistance to leaf-diseases, but until further work has been done on the subject it is unsafe to predict that the solution to the problem of leaf-diseases lies in manuring.

Spraying.—This is the most direct, and where well carried out, the most effective method (except the breeding of totally immune varities) of controlling all leaf-diseases.

The spraying of rubber (or any tall tree) presents a number of obvious difficulties, and in the past it has usually been said in Ceylon that spraying was impossible, or at least would be too costly to carry out.

To be effective a fungicide must be deposited over both sides (particularly the lower) of every leaf, leaving a thin and more or less lasting film over the surface. To attain this economically it is necessary for the spray to be dispersed in a very fine mist, and it is clearly difficult to project such a mist to any considerable distance from the nozzle of the spraying machine.

In South India spraying experiments have been carried out under the supervision of Mr. H. Ashplant, Rubber Mycologist to the U. P. A. S. I., and have definitely proved that in

South India at any rate not only can leaf-fall be controlled, but that it can be controlled economically, by spraying with Bordeaux Mixture. His reports (see the Planters' Chronicle, September 27th, 1924, and July 4th, 1925) state that "the results of the season's operations may be held to have conclusively demonstrated the practicability of the spraying of rubber as an ordinary estate measure." Not only was leaf-fall successfully combated, but trees which had been sprayed for two years showed a girth increment greater by half an inch each year than their unsprayed neighbours, while the yield figures of young sprayed rubber suggest an improved yield response. It is estimated that approximately 10,000 acres of rubber of all ages up to twenty years and more will be sprayed during this season by planters in South India, and every estate, with only one or two exceptions, will have some portion at least of its acreage sprayed.

It has been found that power-sprayers at present on the market possess no advantage over hand-machines, but of the latter Mr. Ashplant states that only one or two types are of any use. For rubber over six or seven years old climbing has to be resorted to, but even with this Mr. Ashplant claims that a single sprayer will cover some 100 acres in a season. Costs in South India vary from Rs. 8/- to Rs. 17/- according to the age of the rubber.

If spraying can be carried out on these lines in South India, it is at least worth while for experiments to be tried in Ceylon. Costs may be greater in Ceylon, but that is a matter for trial. Should further outbreaks of Oidium occur in future years, a heavy tax will be thrown on the resources of the trees by the triple defoliation in one season. It is intended to obtain information as to the most suitable types of sprayers and to experiment with them during next season, particular attention being paid to costs. It is hoped that planters who are interested in the subject will try experiments for themselves, so that the practicability or otherwise of spraying in Ceylon may be definitely ascertained.

R. H. STOUGHTON-HARRIS,
Mycologist.

RUBBER LABORATORIES,
Culloden Estate,
Neboda,
August 8th, 1925.

REPORTS RECEIVED.

A report on "The Preparation of Sole Crepe Rubber in Malaya," by H. C. Pinching, Esq., Senior Scientific Officer, Rubber Growers' Association, Malaya, has been received. This is to be published in the July issue of the Rubber Growers' Association Bulletin and a careful perusal of this report is recommended to all Members of the Rubber Research Scheme.